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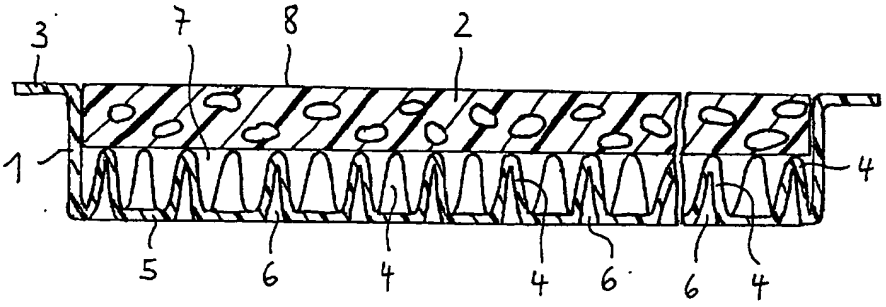
[Fortsetzung auf der nächsten Seite]

(54) Title: SOUND ABSORBER COMPRISING TWO PARTS DELIMITING A HOLLOW SPACE

(54) Bezeichnung: SCHALL-ABSORBER MIT ZWEI EINEN HOHLRAUM BEGRENZENDEN TEILEN



(57) **Abstract:** The invention relates to a sound absorber, particularly for motor vehicles, comprising a molded part (1) made of a thermoplastic material and at least one second part (2) which delimits a hollow space (7) along with the molded part (1). In order to provide such a sound absorber with good media resistance and high heat stability while maintaining or improving the acoustic effectiveness thereof, a plurality of pin-shaped or spike-shaped spacers (4) which extend into the hollow space (7) and are directed towards the second part (2) are configured on the molded part (1), the external side of the molded part (1) being provided with a plurality of recesses (6), each of which extends into a spacer (4).

(57) **Zusammenfassung:** Die Erfindung betrifft einen Schall-Absorber, insbesondere für Kraftfahrzeuge, mit einem Formteil (1) aus thermoplastischem Kunststoff und mindestens einem zweiten Teil (2), das mit dem Formteil (1) einen Hohlraum . (7) begrenzt. Um zu erreichen, Bass ein solcher Schall Absorber bei gleicher oder verbesserter akustischer Wirksamkeit eine gute Medienbeständigkeit Bowie eine hohe Wärmestandfestigkeit aufweist, wird vorgeschlagen, an dem Formteil (1) eine Vielzahl von stift- oder dornförmigen, in den Hohlraum (7) vorstehenden, auf das zweite Teil (2) zu gerichteten Abstandhaltern (4) auszubilden, wobei das Formteil (1) aussenseitig mit einer Vielzahl von Vertiefungen (6) versehen wird, die sich jeweils in einen Abstandhalter (4) erstrecken.

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SOUND ABSORBER

The invention relates to a sound absorber, especially for motor vehicles, comprising a molded part made of thermoplastic material and at least one second part which delimits a hollow space along with the molded part.

Such a sound absorber is known for example from DE 34 45 656 A1. The known sound absorber is composed of an exterior foam layer of open-cell, air-pervious foam plastic, a sound-transparent stabilising layer connected areally thereto and a support layer connected to the edge and to the central area of the stabilising layer. The stabilising layer and the support layer define a hollow space and each consist of thermoplastic material. The stabilising layer is provided with openings which consist of holes punched by means of a needle tool from the foam side. This known sound absorber has fundamentally proved successful in practice. However, as a result of its foam layer under certain usage conditions it does not have satisfactory media resistance. Furthermore the heat resistance of such a sound absorber is relatively limited.

DE 298 03 675 U1 discloses various variants of a sound protection shield with a heavy layer provided with recesses or chambers, which is especially formed of polyurethane, polypropylene, polyolefin elastomers (POE) or EPDM. In one variant (Fig. 7) the heavy layer is formed of EPDM, wherein the chambers are constructed as

respectively pot-shaped in cross-section, together form a honeycomb-shaped structured structure and are covered with a metal or aluminium foil.

DE 195 16 819 C2 describes a sound damping device which is especially intended for application to room-delimiting surfaces and has a cover layer arranged at a distance from the room-delimiting surface. The cover layer comprises a first damping element for low acoustic frequencies and a second damping element for high acoustic frequencies. The first damping element consists of a plate absorber in the form of a closed plastic film wherein the plate absorber is arranged at a distance from the room-delimiting surface by means of a frame-shaped spacer element consisting of foam, forming a cavity. The second damping element on the other hand consists of a porous foam absorber which is arranged on the plate absorber and is connected thereto over the entire area.

It is the object of the present invention to modify a sound absorber of the type specified initially so that this has good media resistance and a higher heat resistance with the same or improved acoustic efficiency.

This object is solved by the sound absorber having the features of claim 1. The sound absorber according to the invention thus is substantially constructed of a molded part made of thermoplastic material and at least one second part which with the molded part delimits a hollow space, wherein a plurality of pin-shaped or spike-shaped spacers, which project into the hollow space and are directed towards the second part are formed on the molded

part. In addition, the molded part has a plurality of recesses on the outside which each extend into a spacer.

By using a molded part made of thermoplastic material which preferably represents an exposed outer side of the sound absorber according to the invention, said sound absorber has good media resistance. An especially good media resistance and temperature resistance can be achieved if the molded part is produced by deep drawing of a polyester film, especially a PET film (polyethylene terephthalate film). The spacers ensure that the spacing between the molded part and the second part and therefore the hollow space defined between the two parts does not vary or at any rate only slightly varies at high ambient temperatures or under the effects of heat. In conventional sound absorbers with an exposed foam layer, temperature- or heat-induced changes in the shape of the foam layer frequently occur, especially if the foam layer is made of PP foam (polypropylene foam).

The molded part of the sound absorber according to the invention is flectionally elastic, has a certain mass and is excited to co-vibrate by sound waves incident thereon. In this case, some of the sound energy is converted into heat. The air-filled hollow space between the molded part and the second part of the absorber acts as an elastic spring. The sound absorber according to the invention is thus a spring-mass system.

The recesses formed on the outside of the molded part are acoustically effective since at least some of the sound waves incident on the sound absorber penetrate into the recesses and make the air contained therein vibrate to and fro. Some of the sound energy is consequently converted into heat as a result of friction effects. Compared with a corresponding sound absorber without such recesses, the volume of the hollow space of the sound absorber according to the invention and thus its overall height are reduced for the same acoustic performance (efficiency).

The spacers are formed as pin-shaped or spike-shaped and thus relatively small and compact. They barely reduce the acoustically

effective volume of the air-filled hollow space of the sound absorber and barely even when they are formed in a relatively large number on the molded part. For example, more than 150, preferably more than 180 spacers per square decimetre are formed on the molded part.

The second part of the absorber according to the invention defining the air-filled hollow space is preferably formed of a heavy layer, a non-woven fabric layer, a foam layer and/or a textile layer. The second part can especially be constructed as multi-layer, for example comprising a heavy mat and a further absorber layer made of non-woven fabric, foam or textile material.

The molded part is preferably constructed as cassette-shaped or dish-shaped, wherein the depth of the cassette or dish is preferably greater than the respective length of the spacer. The second part, for example, a heavy mat, can then be inserted into the molded part and terminate flush with the rear-side edge of the molded part. By this means the second part and the hollow space can be protected from dirt accumulation by dust or the like.

It is also advantageous if the molded part has a circumferential fixing flange. The sound absorber according to the invention can then be affixed simply to bodywork parts and machine parts, for example, using screws, rivets, clamps or adhesives.

Further preferred and advantageous embodiments of the sound absorber according to the invention are given in the dependent claims.

The invention is explained in detail subsequently with reference to drawings showing several exemplary embodiments. In the figures, shown schematically not to scale:

Fig. 1 is a cross-sectional view of a sound absorber according to the invention,

Fig. 2 is a plan view of the outside of the sound absorber from Fig. 1,

Fig. 3 is a plan view of the outside of a sound absorber according to a second exemplary embodiment,

Fig. 4 is a cross-sectional view of a sound absorber according to the invention according to a third exemplary embodiment and

Fig. 5 is a cross-sectional view of a sound absorber according to the invention according to a fourth exemplary embodiment.

As shown in Fig. 1, the sound absorber is made of a molded part 1 and at least one further acoustically effective part 2. In the exemplary embodiment shown in Fig. 1, the second part 2 is a heavy mat, preferably made of recycled material. Instead of a heavy mat or additionally thereto, sound-absorbing materials such as non-woven fabrics, foams and acoustically effective textile mats can also be applied to the back of the molded part 1. The molded part 1 consists of thermoplastic material and was produced by deep drawing a corresponding air-impervious plastic film. The plastic film is a polyester film and is preferably a PET film.

The molded part 1 is substantially cassette-shaped or dish-shaped and has a circumferential fixing flange 3 (see Fig. 2). The fixing flange 3 can be provided with holes (not shown) which serve for the connection of screws, rivets, clamps, fixing naps or adhesives on the molded part 1.

Constructed on the inside of the molded part 1 is a plurality of spacers 4 which are substantially constructed as spike-shaped and are formed by means of a shaping tool having needle-shaped pins or the like. Accordingly, on its exposed outer side 5 the molded part 1 has a plurality of recesses 6 which each extend into a spacer 4. The spacers 4 and recesses 6 are preferably produced during the deep drawing of the molded part 1. However, it is also possible to produce the spacers after the deep drawing of the cassette-shaped molded part 1 in a subsequent work process. It can be made out that the average outside diameter of the spacers 4 is smaller than their average length.

The cassette-shaped molded part 1 and the heavy mat as the second part 2 of the sound absorber define a hollow space 7. The spacers 4 project into the air-filled hollow space 7 and are directed towards the heavy mat 2. The recesses 6 are closed towards the hollow space 7. In this exemplary embodiment the spacers 4 are substantially the same length and extend as far as the heavy mat 2. The depth of the moldied part 1 is greater than the respective length of the spacers 4 so that the heavy mat 2 is taken up in the molded part 1. The depth of the molded part 1 and the length or height of the spacers 4

are dimensioned such that the back side 8 of the heavy mat 2 terminates substantially flush with the back side (contact surface) of the fixing flange.

In the exemplary embodiment shown in Figures 1 and 2 the spacers 4 are formed as substantially the same shape since they have substantially the same length or height and substantially the same average outside diameter. Likewise the recesses 6 formed in the spacers 4 have substantially the same depth and substantially the same average inside diameter. Furthermore, the spacers 4 and the recesses 6 are formed as distributed uniformly over the surface of the molded part 1 as shown in Fig. 2.

Since the sound field emanating from a noise source generally has a non-uniform intensity distribution and a non-uniform frequency distribution, the acoustic efficiency of the sound absorber according to the invention can be improved under corresponding usage conditions if the spacers 4 and recesses 6 are constructed as non-uniformly distributed over the surface of the molded part 1, as shown schematically in Fig. 3. Moreover, it can be advantageous if the recesses 6 have different internal diameters (see also Fig. 3).

A further possibility to improve the acoustic efficiency of a sound absorber according to the invention consists in shaping the spacers 4 such that they have different lengths and/or the recesses 6 such that they have different depths. In this case, areas with spacers 4 of different lengths can be constructed on the molded part 1, with the spacers 4 in the different areas each having

the same length. Accordingly, areas with recesses 6 of different depths are then also formed on the molded part 1, as shown schematically in Fig. 5. The second part 2, which again comprises a heavy mat or a foam layer for example, has areas of different thickness corresponding to the length or height profile of the spacers 4.

The exemplary embodiment shown in Fig. 4 differs from the exemplary embodiment according to Fig. 1 in that inserted first into the cassette-shaped molded part 1 is a non-woven fabric layer 9 which abuts onto the tips of the spacers 4. The non-woven fabric layer 9 is followed by a second layer 2, in the form of a heavy mat or a foam layer, whose back side 8 again terminates flush with the fixing flange 3.

The invention is not restricted in its embodiment to the exemplary embodiments described hereinbefore. Rather, a plurality of variants are feasible which also in a fundamentally different embodiment make use of the inventive idea as defined in the appended claims. Thus, for example, it is also within the scope of the invention to fill the hollow space 7 in the area between the spacers 4, partly with acoustically effective material, especially with heavy material.